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The Influence of Water
In a Ration for Pigs

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THE INFLUENCE OF WATER IN A RATION FOR PIGS

BY

FRANK M. BURGESS

AND

WILLIAM EVERETT HEDGCOCK

THESIS

For the Degree of

BACHELOR OF SCIENCE

IN AGRICULTURE

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THIS IS TO CERTIFY THAT THE THESIS PREPARED UNDER MY SUPERVISION BY

Frank M. Burgess and
William Everett Hedgcock

ENTITLED

The Influence of Water in a Ration For Pigs

IS APPROVED BY ME AS FULFILLING THIS PART OF THE REQUIREMENTS FOR THE

DEGREE OF

Bachelor of Science

V. Dietrich

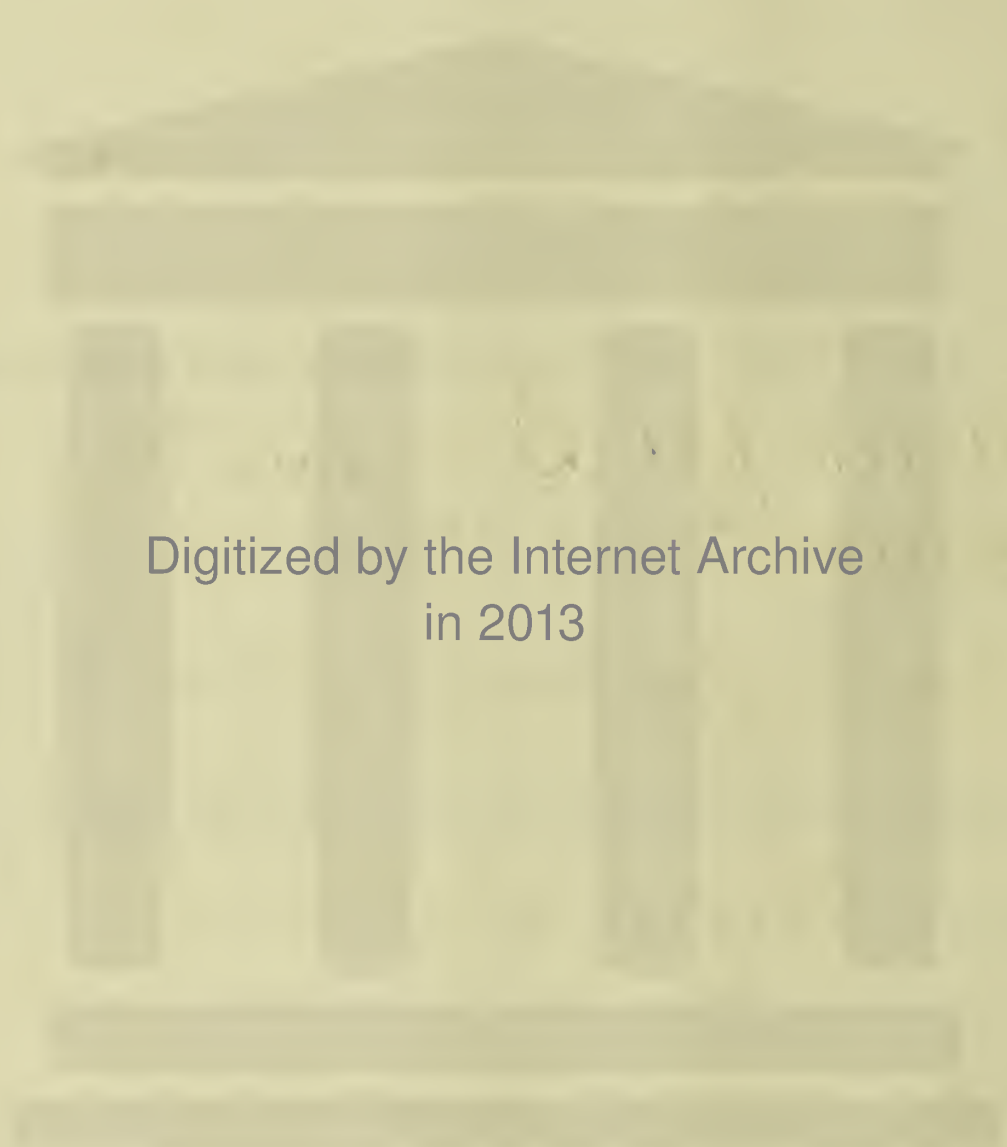
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Introduction

In 1904 an investigation was started by Professor Dietrich to determine the factors that affect swine feeding . In this investiation, at times, when it was thought that every thing had been provided for, new factors have so influenced the experiments that they have had to be repeated . Among these factors is the water problem.

Purpose

The purpose of this experiment was to determine the influence water had upon a ration for pigs. The following questions are considered - : Will a pig receiving a certain definite amount of water in his feed do better than one that has free access to water ? What are the relative efficiencies of dry feed, thick slop, and thin slop ?

The Plan of the Experiment.

The pigs were removed from their dams at two months of age and were immediately placed on experiment . The feeding period was of six months duration allowing the pigs to finish at eight months of age. To do this the six months is divided into two periods. The first four months is a growing period and the last two months is a fattening period.

Three lots of eight pigs were used in the experiment , all three lots received the same proportionate amounts of digestible nutrients. The feeds were made up of two parts of corn to one of red dog flour with enough tankage to supply the proper amount of protein. This was for the growing period for during the fattening period the pigs received as much corn

meal as they desired and one pound per head of red dog flour. The only difference between the lots was the way the water was used in the ration. Lot I received dry feed three times per day ; Lot II a thick slop, and Lot III a thin slop. Both lots I and II had free access to a water trough while Lot III got no water except that put in with the feed. Correctives in the form of salt, charcoal, bonemeal , and lime were kept where the pigs could reach them and an occasional load of cinders was placed in the lots.

The ration used was made up according to Professor Dietrich's standards for protein and carbohydrate requirements. The water, as fed to Lot III , was also computed from a standard that had given the best results but was not thoroughly established. No attention was paid to a nutritive ratio as is used in the old German standards.

The experiment started October 17, 1908 and continued 26 weeks closing April 17, 1909. The pigs were weighed individually at the start and once a month after that. Each lot was weighed as a lot, every Saturday morning before the first meal. The water given to Lots I and II was weighed into the troughs from day to day and what was left was weighed back at the end of the week.

The Equipment.

During the first six week the pigs were kept in three pens of about one-eighth of an acre extent. Each lot contained a floorless cot, a wooden feeding floor, and the feed troughs. These troughs were arranged under a swinging gate so that the ^{pigs} ~~feed~~ could be kept out while the feed was being placed into

the trough.

The correctives were fed in a trough near the feed trough. A special watering trough was provided for both Lots I and II. This was made of galvanized iron and was fastened to the ground by a frame. It was 30" long, 6" deep, and 6" broad. It was provided with a cover in which there were two holes through which the pigs could get the water but could not spill the water out or get it very dirty.

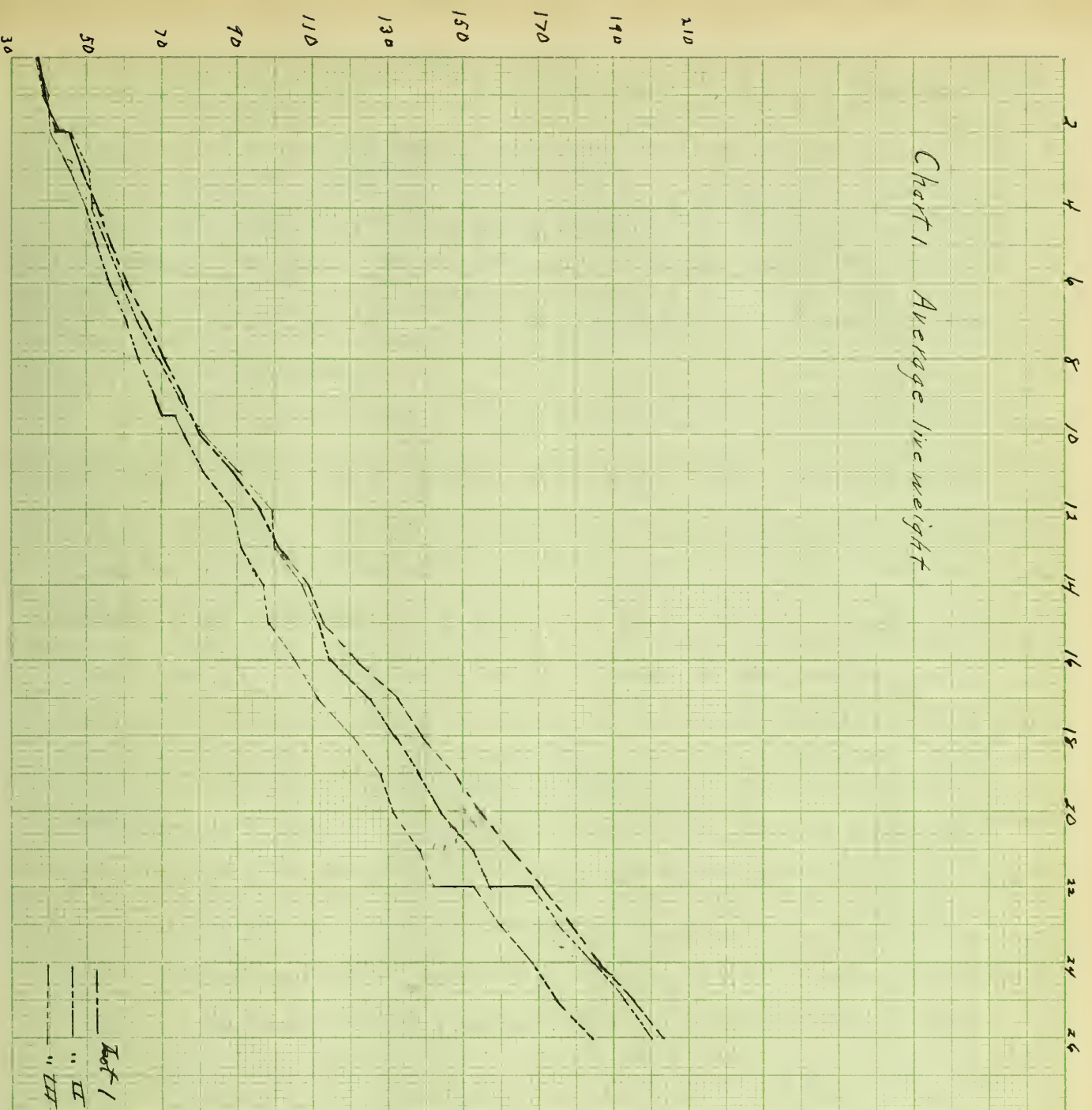
After the first six week pens were changed. Lot I went into a pen about 20' x 100' in size. Lot II into a pen 20' x 100', and lot III into a pen 50' x 100'. Lot III had no feeding floor but their trough was placed on cinders. The trough in lot I was provided with a high back so that the feed (dry feed) would not be wasted as the dry feed was not easy for the pigs to handle. Bedding was provided in the form of shredded sodder.

The Experiment .

The pigs for the lots were selected and weighed October 16 and October 17 the experiment was started,. At first it seemed as though the pigs were not getting enough to eat as they remained about the trough for some time after the feed was consumed but the gradual increase of feed together with changing weather conditions caused them to go off feed. The increases in feed , however, were made no faster than the gains and ages called for and were what could have been eaten under normal conditions. The reason for the lots being off feed could not be explained at first but a study of the conditions of the experiment soon brought it to light. The pigs did not take much exercise. The pens were small and as the weather grew cooler the pigs spent most of their time in their nests. This was particularly true of lots II and III as they would hurry back to their nests. With Lot I it was a little different. They had to spend much more time at their troughs because the dry feed could not be eaten as rapidly as the slops. They had to spend from a half to three quarters of an hour on their feet at feeding time while the other two lots were through in five minutes. After Lots II and III went off feed scarcely a week went by in which one or more feeds were ^{not} missed while Lot I ate their feed with great regularity most of the time. As a result , Lot I made steady gains - although not very large ones, from start to finish while the other lots were more erratic in gains. Lot III made very excellent gains at times but their extremely poor gains at other times kept them below Lot I, and Lot II was hopelessly behind.

Lots II and III had two periods of being off feed and they were : the fourth ~~week~~ and the thirteenth week. During the first period Lot II was off feed for four weeks and Lot III two weeks. The second period lasted for three weeks and Lot I was also affected part of the time. Lots II and III made poor gains from the twentieth to the twenty-second week but this was due to ~~two~~ individuals in the lot that were not as thrifty as they should have been.

Chart 1. Average live weight



Average Live Weight.

Chart I represents the average live weights of the lots by weekly periods. The periods are designated by the figures at the top of the chart and the weights by the figures at the left of the chart.

The average weights at the beginning of the experiment were Lot I 36.5 #, Lot II 36.6#, and Lot III 36#. The increases in weight appear to run up quite gradually except when pigs were removed from the lots as it was necessary at time to remove individuals that were not doing well. At the end of the second week all three lots had an average weight of 42# but the removal of the smallest pig from each lot increased the average weight. The removal was necessary because the pig taken from Lot III had trouble in eating and was unable to get its share of the feed. In its attempts to eat, it was continually choking and wheezing and often left the trough without taking more than a few mouthfuls. This removal of pigs put Lot III about a half pound in the lead but as both Lots II and III went off feed in the fourth week Lot I made much better gains and weighed the most. From this time on there was always more or less trouble in keepings Lots II and III on feed. It was the beginning of cold weather and as the pigs were quite small they spent most of their time in the warm cots. Their lack of exercise had a great influence upon their appetites and hence upon the size of their gains. Lot I, because of the nature of their feed, was compelled to spend more time in the open, and so this factor did not work against them to the extent that it did in Lot II and III. A steady gain was the only thing that kept them in the lead, how ever,

because when Lot III was able to consume all of its feed a much larger gain was made than was ever made by Lot I, but Lot III not only made the largest weekly gain but it also made the smallest.

On November 30th a pig in Lot I died from kidney troubles and was replaced by one of equal weight. At the eighth week the average weights were : Lot I 70.8#, Lot II 64#, and Lot III 69.7#. Lot II never made as good gain as either Lots III, or I until during the last two weeks of the experiment so that its average weight was further and further from the others during the rest of the experiment. In the middle of the ninth week one of the smaller pigs in Lot II had to be removed and was replaced by one that was 25# heavier. The continuous off feed had seemed to have affected this pig much more than it did the rest of the lot and it became so unthrifty that it began to lose in weight. When placed in a larger pen it showed considerable improvement but finally died. The size of the new pig was just the average of the lot. At the twelfth week Lot III weighed 98.9# ; Lot I 96# and Lot II 88.3#. In the thirteenth week Lot I continued their fair gain while Lots II and III made small ones. From this time on Lot I always had the best weight although Lot III often made better gains. At the sixteenth week Lot I weighed 122.5# ; Lot III 115#, and Lot II 105.5#. At the twentieth week Lot I weighed 154.8#, Lot III 144#, and Lot II 131.1#. At this time and for a short time before it was noticed that a pig in each of Lots II and III were not making gains but it was thought that they might improve if left in the lots. However, they did not do so,

and were removed at the end of the twenty-second week. These pigs showed all signs of overfeeding. They seemed to be the most affected by the conditions of the experiment and developed a delicate appetite often missing entire meals. The pig from Lot III was given doses of salts at different times throughout the winter but in the latter part of March no treatment seemed to help it and it was removed. The pig from Lot II did not appear thrifty in the winter but had a good appetite, however, in March it began to refuse feed so that it was also removed from the experiment. Lot I weighed 170.5# at the twenty-second week. The removal of the pig from Lot III brought the average from 156.8# up to 168.6# and Lot II was raised from 142# to 152.3#. From this time on Lot II made the best gains but were unable to overcome the handicap the other Lots held. Lot I was more erratic in their gains at this time while Lot III made steady fairly good gains. At the twenty-sixth week Lot I weighed 201.7#, Lot II 184.6# and Lot III 200#.

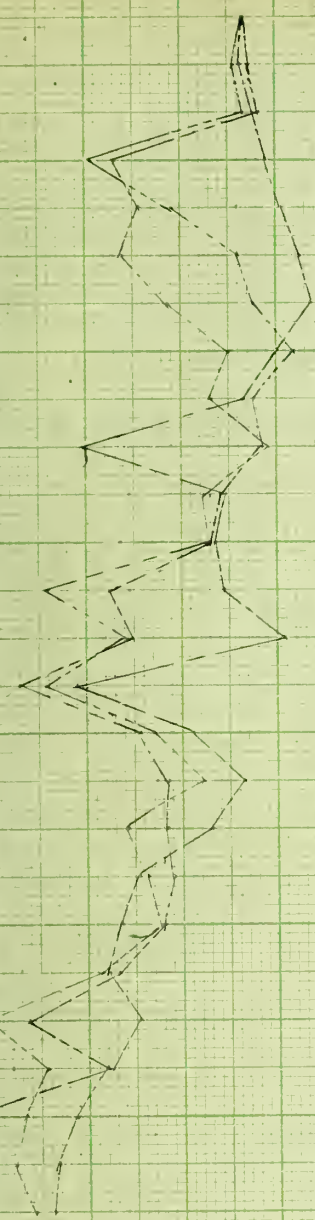
Following is a table of the average weights by weeks :

Weighings	Lot I	Lot II	Lot III
1	36.6	36.5	36
2	39	39.2	38.5
3	42	42.2	42
4	48.5	48.2	50.2
5	52.8	50	51.8
6	56.9	53.1	56
7	61.4	56.5	60.5
8	66	61.1	63.1
9	70.8	64	69.7
10	78.2	68	75.7
11	80	76	80.8
12	88.5	80.5	91.7
13	96	88.3	98.3
14	101.5	90.5	100.5
15	109.1	97.1	107.1
16	113.1	98.5	110.5
17	122.5	105.5	115
18	132.5	111.7	125
19	139.7	121.4	132
20	148.2	128.5	138
21	154.8	131.1	144
22	162.5	138.8	152.8
23	170.5	142	156.8
24	178.8	160	175.3
25	186	168.3	185.6
26	195.4	175.6	193.3
27	201.7	184.6	200

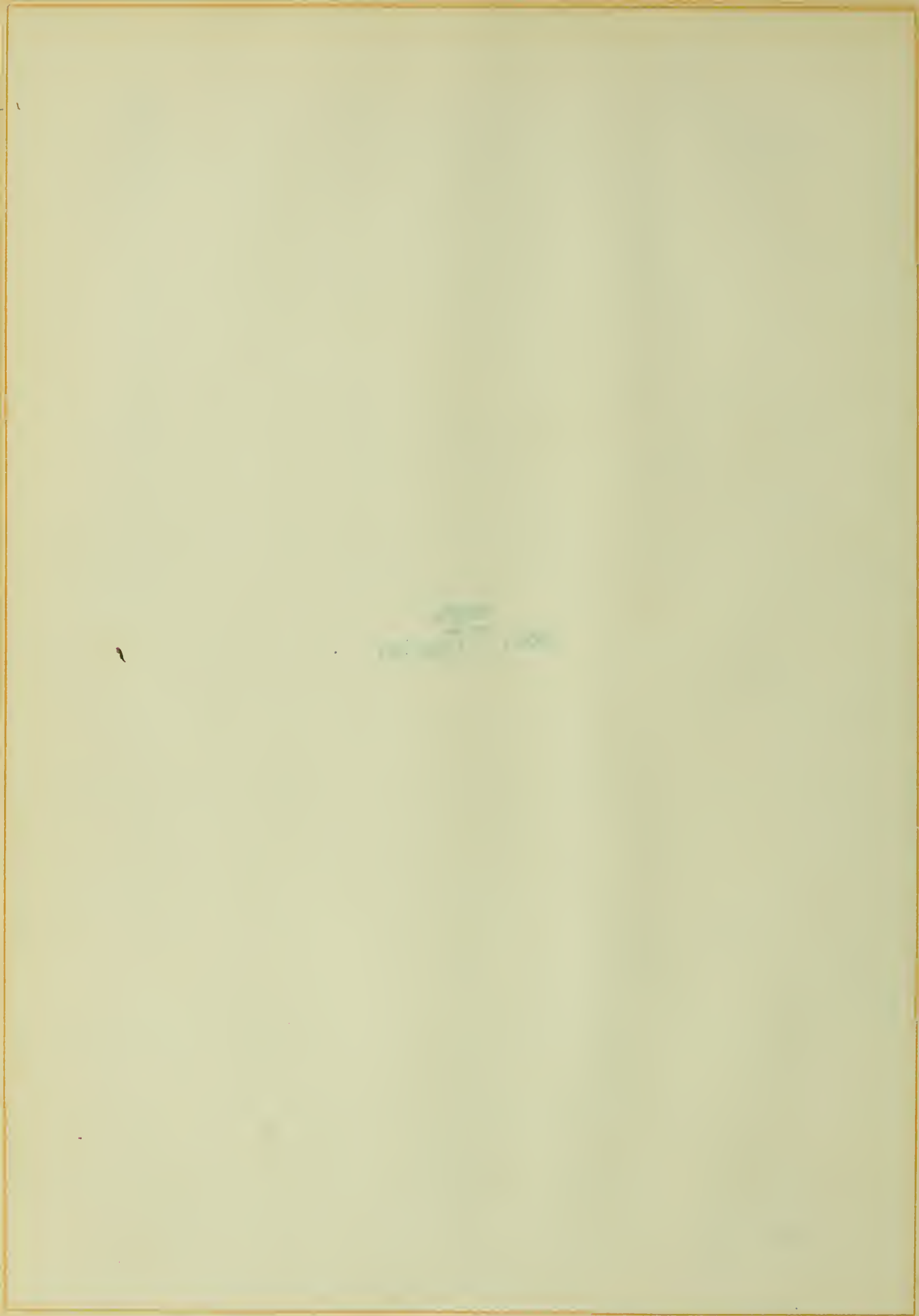
This table shows the average weights by weeks in a different form from that of Chart I .

Chart 2 Feed per 100# live weight

2 4 6 8 10 12 14 16 18 20 22 24 26



Lot I
II
III



Amount of Feed eaten per 100# Live weight,.

Chart 2 shows the amount of feed eaten per 100# live weight per day. The weekly periods are designated by the figures at the top and the pounds of feed per 100# at the left.

The rations fed were made up according to the requirements for protein and carbohydrate and not according to a nutritive ratio hence the feed per 100# live weight varies according to the use and fall of these curves. The carbohydrates curve starts with 2.2# per 100# and rises gradually to 2.6# at the 18th week. The protein curve starts at .6# , rises to .7# at the 7th week, drops to .6# at the 11th week and rises to .65# at the 12th week and continues at this point until the 18th week. The 18th week makes the close of the growing period of the experiment and the beginning of the fattening period. During the fattening period the ration consists of one pound of red dog flour per head and all the cornmeal that they will eat with no tankage whatever. For the first eight weeks the rations were made up according to one table of digestible nutrients, and after that according to another table. In figuring the average digestible nutrients, fed per week, later, the second table was used, which showed that for the first 7 weeks an excess of carbohydrates and a smaller amount of protein was fed. In the old table the nutrients were as follows :

Corn Meal					Middlings					Tankage				
Water	D.M.	Pro.	Car.	E.E.	Water	D.M.	Pro.	Car.	E.E.	Wat.	D.M.	Pro.	E.E.	
.14	.86	.08	.66	.03	.12	.88	.13	.43	.04	.05	.95	.46	.13	
The new table was :														
.13	.87	.07	.66	.03	.12	.88	.08	.66	.02	.07	.93	.50	.13	

The first week Lot I received 4.32# per 100# live weight, Lot II 4.31#, and Lot III 4.32#. The 2nd week Lot I received 4.33# Lot II 4.35# and Lot III 4.29#. The 3rd week brought another slight increase to all the lots and the 4th week brought Lot I up to 4.44# but Lots II and III went off feed. Lot II ate 3.69# and Lot III 3.50#. This was the first period of going off feed due apparently to the lack of exercise. The novelty of the strange lots had completely worn off and the advent of cold weather caused the pigs to stay most of the time in their cots. Presumably their systems gradually became clogged up until they finally refused feed entirely. Then their systems gradually cleared themselves of the excess of feed and the pigs appetites were restored. One pig in Lot II, however, failed to get over the attack and had to be replaced two or three week later by another. Lot III ate less than 4.00# of feed per 100# for two weeks while Lot II was off feed for four weeks. After the recovery was made, there was a period of a few weeks during which, few feeds were missed, and some good gains were made. Lot I at the 7th week were eating 4.67# of feed but at this point marks the beginning of the decrease in protein there was a gradual decrease in total dry feed. The 9th week marked the change of tables with a further decrease in feed for all lots. In the 10th week Lot I was off feed and ate 3.49#. This was the first time that the factor of exercise affected them and the period lasted only a week. The 13th week was the second period of general off feed. This affected Lots II and III at first but in the 15th week Lot I was also affected. Exercise apparently was the controlling factor at this time, as it was, at the first period. Lot II after the

12th week never ate 4.00# of feed per 100# live weight and Lot III rose above 4.00 # at only one time. As before Lot I showed the least effects of the deranged conditions and were off feed only one week while Lots II and III were off feed for 4 weeks. During the 15th week Lot I ate 3.46#, Lot III 3.27#, and Lot II 3.19#. A general reduction in feed was made at this time. Before this time the gains for the week were estimated from the previous gains and the rations were made out accordingly but after the 15th week the rations were made out as though no gain was to be expected during the week. This change was of slight advantage as some of the pigs in Lot II and III had such delicate appetites that they would not eat their proportionate amounts of feed.

The end of the growing period marked a decrease in the total amount of feed because cornmeal was not added as rapidly as the tankage was dropped out except that Lot II showed a slight increase at this time. Lot I received 4.15#, Lot II 3.93#. and Lot III 3.73#. The cornmeal was increased rapidly for a while but with the coming of warm weather, together with the delicate appetites of some of the pigs, the amount was decreased. At this time a pig from each of Lots II and III began to show such evident signs of derangement that they had to be removed. They had never fully recovered from the effects of the second period of off feed but had been left in the experiment as long as they did not go entirely wrong. They were removed at the close of the 22nd week. Their removal gave the other pigs a better chance and fairly good gains were made during the last month. The feed per 100# live weight gradually decreased and at the close Lot I was receiving 3.02#, Lot II

3.33 $\frac{1}{2}$ and Lot III 3.21 $\frac{1}{2}$. Lot I ate during the entire experiment 3588.1 $\frac{1}{2}$ of cornmeal ; 1,238.1 $\frac{1}{2}$ of middlings and 456.9 $\frac{1}{2}$ of tankage. Lot II ate 2989.1 $\frac{1}{2}$ of corn ; 1065.8 $\frac{1}{2}$ of middlings and 382.7 $\frac{1}{2}$ of tankage. Lot III ate 3232.2 $\frac{1}{2}$ of corn ; 1132 $\frac{1}{2}$ of middlings and 418.8 $\frac{1}{2}$ of tankage.

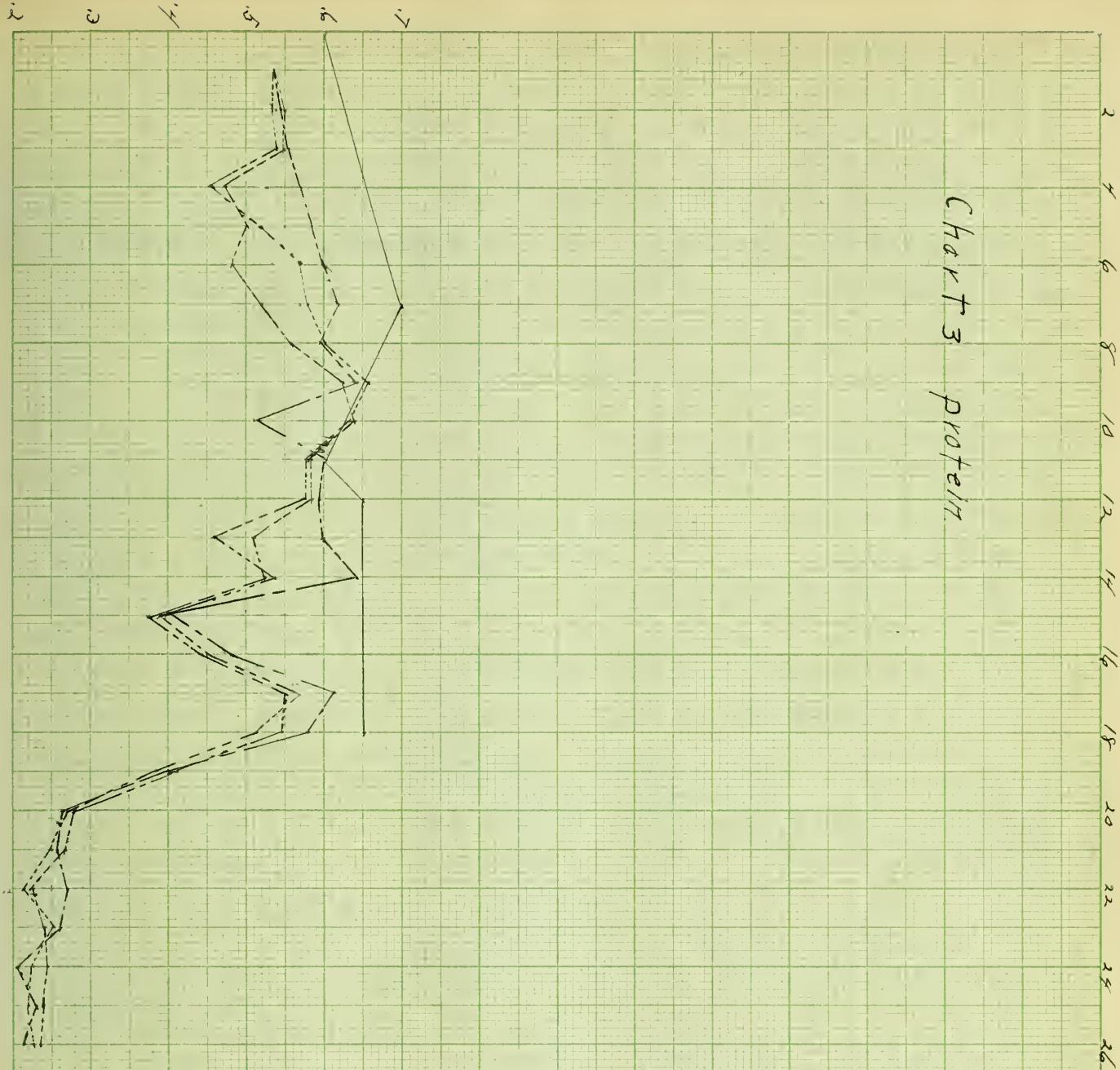
The following table gives the amounts of feed per 100 $\frac{1}{2}$ live weight. It will be seen that Lot I ate the largest amount of feed and Lot II the least with Lot III about midway between the others :

Pounds Feed per 100 $\frac{1}{2}$ Live weight.

Pounds	Lot I	Lot II	Lot III
1	4.32	4.31	4.32
2	4.33	4.35	4.29
3	4.38	4.40	4.36
4	4.44	3.69	3.50
5	4.53	3.79	3.96
6	4.61	3.69	4.32
7	4.67	3.92	4.40
8	4.51	4.26	4.60
9	4.32	4.17	4.38
10	3.49	4.44	4.41
11	4.24	4.12	4.22
12	4.18	4.17	4.19
13	4.22	3.65	3.29
14	4.53	3.74	3.74
15	3.46	3.19	3.27
16	4.07	3.77	3.85
17	4.34	3.93	4.13
18	4.15	3.93	3.73
19	3.79	3.95	3.82
20	3.68	3.92	3.90
21	3.61	3.67	3.58
22	3.77	3.18	2.97
23	3.63	3.61	3.52
24	2.85	3.43	3.19
25	3.23	3.37	3.11
26	3.02	3.33	3.21

Lot	Total Feeds eaten		
	Corn	Middlings	Tankage
I	3588.1	1238.1	456.9
II	2989.1	1065.8	382.77
III	3232.2	1132	418.8

Chart 3 Protein



Lot I
Lot II
Lot III
Standard

Protein

Chart 3 represents the amount of protein fed per 100# live weight. The figures at the top of the chart show the weekly periods and those at the left show the value of the variations of the curve.

The protein curve starts at .6# per 100# live weight , rises to .7 # during the first seven weeks, drops to .6# again by the end of the 11th week, then rises to .65# by the end of the 12th week and continues at this rate until the 18th week when the protein requirement, except in a general way, is disregarded as the growing period is over and the fattening period started. The decrease in the middle of the curve is necessary to get rid of a part of the protein waste .

The curves for the lots did not start as high as the requirement because of the higher protein values of the feeds in the first table used in compounding rations. Lot I started with .536# and made a regular rise ^{to} ~~at~~ .62# at the 7th week. It dropped during the 8th week to .597#, and then , with the corrections of the table as given in the discussion of total feeds, rose to .64# at the 9th week. Further reduction of protein as called for in the standard, together with a period of off feed depressed the curve to .51# at the 10th week. The curve rose to the standard of .6# at the 11th week where it remained practically stationary for three weeks although the standard rose to .65# . However, the curve rose to .63# at the 14th week. During the 15th week, a shortage of tankage, cold weather, and going off feed, caused the curve to fall to .4#. The 17th week brought the curve back to .61# . There

was a fall to .58# at the 18th week and then the tankage and most of the middlings were replaced by cornmeal which, caused the curve to fall to less than .3# . After that the curve fluctuated slightly but only enough protein was fed for the maintenance requirement.

The curves for Lots II and III started at .535# and maintained this level for about 3 week , then the skipping of feeds during the 4th week depressed Lot II to .47# and Lot III to .45#. These curves show great fluctuations throughout the period. After the 4th week Lot III made a more or less gradual rise to .655# at the 9th week which is slightly above the standard. Lot II at the 6th week were at .485 but then made a gradual rise to .64 at the 10th week. Then for 3 weeks Lots II and III ran about the same. Both dropped to .585 # at the 11th week. They remained at this mark for the 12th week but in the 13th Lot II fell to .51# and Lot III to .46#. This was one of the periods that these lots were off feed. At the 14th week they had risen to .53 but the shortage of tankage and the off feed period of the 15th put both down to .375#. Recovery was rapidly made and at the 17th week Lot II received .55# and Lot III .57#. The 18th week brought a slight decrease and then as the tankage and middlings were decreased the curves fell to the low point of .28# at the 20th week. From then on there were slight variations with a finish^{of} .237 for Lot II and .23# for lot III. The fact that they went off feed which affected the lots at different times kept the amount of protein fed below the standard at most of the periods. These causes affected Lots II and III to a much greater extent than they

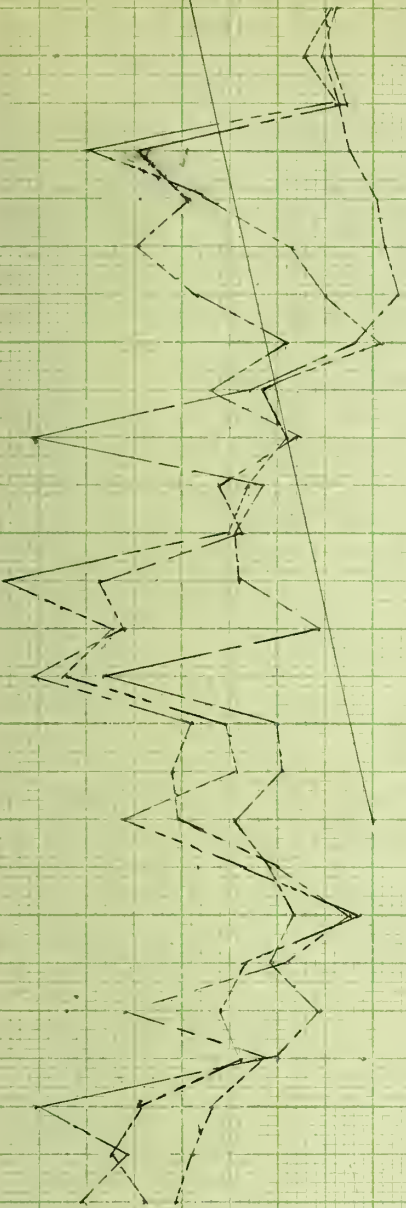
did Lot I.

The following table shows in figures the amounts of protein fed to the different lots. The periods of off feed can be easily determined from an inspection and the dropping out of tankage is clearly shown by the great decrease after the 18th week .

Protein

	Lot I	Lot II	Lot III
1	.536	.535	.538
2	.542	.550	.547
3	.553	.555	.546
4	.569	.474	.451
5	.584	.505	.522
6	.605	.483	.569
7	.623	.520	.581
8	.598	.554	.603
9	.643	.626	.656
10	.510	.640	.637
11	.600	.583	.589
12	.597	.586	.591
13	.604	.511	.459
14	.644	.526	.536
15	.405	.373	.373
16	.482	.448	.447
17	.614	.550	.570
18	.580	.548	.518
19	.404	.411	.398
20	.264	.281	.279
21	.259	.2263	.256
22	.270	.228	.212
23	.260	.243	.251
24	.204	.245	.229
25	.231	.241	.222
26	.216	.238	.230

Chart Carbohydrate



Lot I
 " II
 " III
 Standard

Carbohydrate.

Chart 4 represents the amount of digestible carbohydrate fed per 100% live weight, as in other charts the figures at the top represent the weekly periods and those at the left the value of the curves in pounds.

The requirement is 2.2% of digestible carbohydrate per 100% live weight for a two months old pig and 2.6% for a six months pig. During the last two months there is no standard because the pigs are fed with a view of fattening and get what they will eat up clean.

For the same reason that kept the protein curves below the standard, the carbohydrate curves were forced above the standard. This was due to the use of a digestible nutrient table in which the carbohydrate in the feeds was rated too low and the protein too high. This was corrected at the beginning of the ninth week.

During the first three weeks all three lots received about the same amount of carbohydrate. Lot I received 2.53% per 100% live weight, Lot II 2.50 and Lot III 2.51%. Lot I dropped to 2.5% for the 2nd week because of a larger gain being made than was expected. Then they made a slow gradual increase to 2.65% at the 7th week. A single feed was missed in the 8th week which caused a reduction to 2.56%. The 9th week brought a decrease to 2.34% because of the change in the table of digestible nutrients. The 10th week was an off feed period for the lot and the curve fell to 1.89% but the 11th week brought them back to 2.37 or .07% under the standard. A slight drop to 2.31% was made in the 12th but the 13th brought them up to 2.49% or only .02% below the standard. The 15th week was cold so that some feeds were missed be-

feed for a day or two so that the curve fell to 2.05#. It was at this time that all the lots were off feed together. During the 16th week Lot I received 2.4#. A slight decrease was made at the 18th week when the curve touched 2.31# or .29# under the standard but as the cornmeal was increased rapidly at this time the curve rose to 2.43# at the 20th week. After the 13th week scarcely a week went by but that the lots missed one or more feeds and after the 15th a slight reduction in feed was made but it did not improve conditions very much.

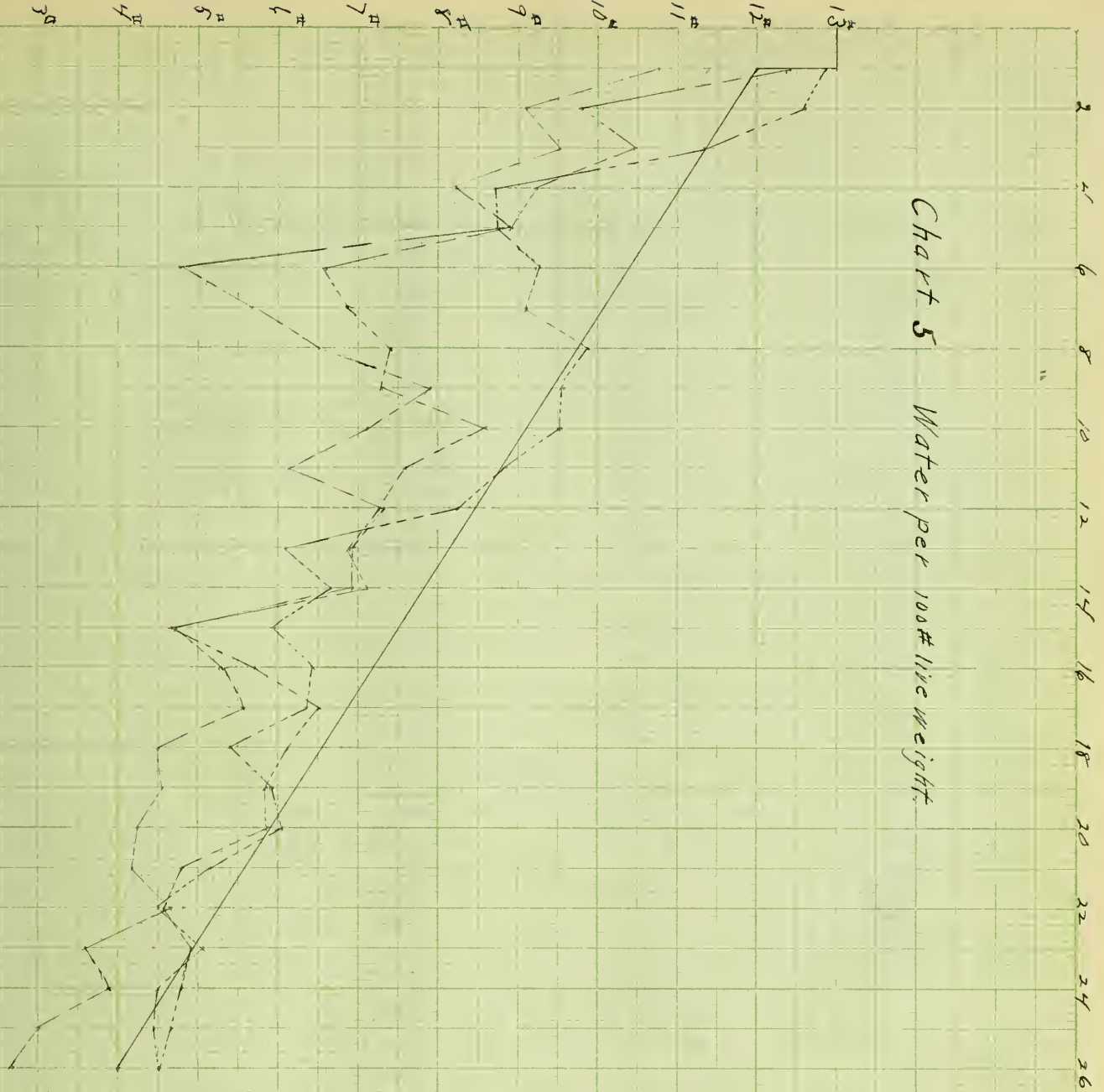
After the 20th week considerable variations was made in the carbohydrate curve by Lot I. At the 22nd week they received 2.49# and the 24th 1.89# and they finished with 1.99#.

Lots II and III were receiving 2.54# and 2.52# per 100# during the 3rd week but with the coming of colder weather during the 4th week Lot II dropped to 2.11# and Lot III to 2.00#. This was the first time that they went off feed but the colder weather seemed to be a great incentive to keep them in their cots so that they did not take enough exercise. Lot II was off feed for several weeks but Lot III made a fairly rapid recovery. At the 18th week Lot II received 2.42# or .04# more than the standard and Lot III received 2.62#. The correction of the card put the curves down below the standard for the 9th week. Until the 13th week the feed varied between 2.3# and 2.4#, as some feeds were missed, and at other times larger gains were made than was expected, but the 13th week was a time of off feed. Lot II dropped to 2.03# and Lot III to 1.83#. Lot II rose to 2.08# at the 14th week and Lot III to 2.06#. As these lots were still off feed the 15th week decrease did not affect them as much as it did Lot I but Lot II fell to 1.89# and Lot III to

1.96#. The 16th week brought an increase to 2.22# for Lot II and 2.29# for Lot III. These lots were so badly affected that they did not approach the standard at all closely after cold weather set in and they had become more inactive. After the tankage was dropped out and the middlings greatly decreased the carbohydrate rose to 2.55# for Lot II and 2.57# for Lot III. A pig from each lot started to go wrong at this time but were carried along for some time with the hope that they might recover but as they grew worse they were removed after many feeds had been missed on their account. They were removed at the close of the 22nd week when the carbohydrate had fallen to 2.08# for Lot II and 1.96# for Lot III. These pigs not only failed to gain but lost weight and their removal was necessary because they would seldom consume their portion of the feed and hence would leave an excess for the others which some times resulted in the entire lot getting off feed. The 23rd week brought Lot II up to 2.38# and Lot III to 2.32 # but after that the warm weather brought about a slight reduction in feed and the curve fell to 2.19# for Lot II and 2.12# for Lot III at the finish.

The following table gives the amounts of carbohydrate eaten per hundred pounds live weight by weekly periods. The many variations show clearly how the off feed periods affected the curves at time while the slighter variations are the results of gains other than those estimated, being made. Lot I ate more digestible carbohydrate than the other lots most of the time.

Chart 5 Water per 100# live weight.



Lot I
 " II
 " III
 Standard.

Pounds of Carbohydrates per hundred pounds live weight per day.

Week	Lot I	Lot II	Lot III
1	2.53	2.50	2.51
2	2.50	2.51	2.46
3	2.53	2.54	2.52
4	2.55	2.11	2.01
5	2.60	2.21	2.25
6	2.63	2.11	2.44
7	2.65	2.23	2.50
8	2.56	2.42	2.62
9	2.35	2.26	2.37
10	1.90	2.44	2.42
11	2.37	2.28	2.38
			2.31
12	2.31	2.32	1.83
13	2.32	2.03	2.06
14	2.49	2.08	1.96
15	2.05	1.89	2.29
16	2.40	2.22	2.31
17	2.41	2.19	2.08
18	2.32	2.19	2.33
19	2.39	2.40	2.57
20	2.43	2.59	2.36
21	2.39	2.42	1.96
22	2.49	2.08	2.32
23	2.40	2.39	2.11
24	1.89	2.26	2.05
25	2.09	2.22	2.12
26	1.99	2.20	

Water

Chart 5 shows the amounts of water fed and the variations from the standard. The weekly periods are designated at the top of the chart and the value of the curves in pounds is shown at the left.

The purpose of this experiment was to throw light upon the water requirements in rations so that this chart is the most interesting of the series. Past experiments have shown that a larger amount of water per 100# is necessary for a young pig than for older pigs. The data at hand at the beginning of the experiment indicated that about 1.2# of water per 100# for a pig 2 months old and that a gradual decrease of this amount to 4# per 100# at 8 months is the way that the curve should run. The increase in live weight should be rapid enough to gradually increase the total amount of water fed while the decrease in the amount per 100# will permit of the addition of dry feed without much difference in the bulk that is fed. It is impossible to get a pig to consume these absolute amounts when all or part of the water is fed separate from the feed so that Lot III which was fed according to the standard received their feed in the form of a thin slop.

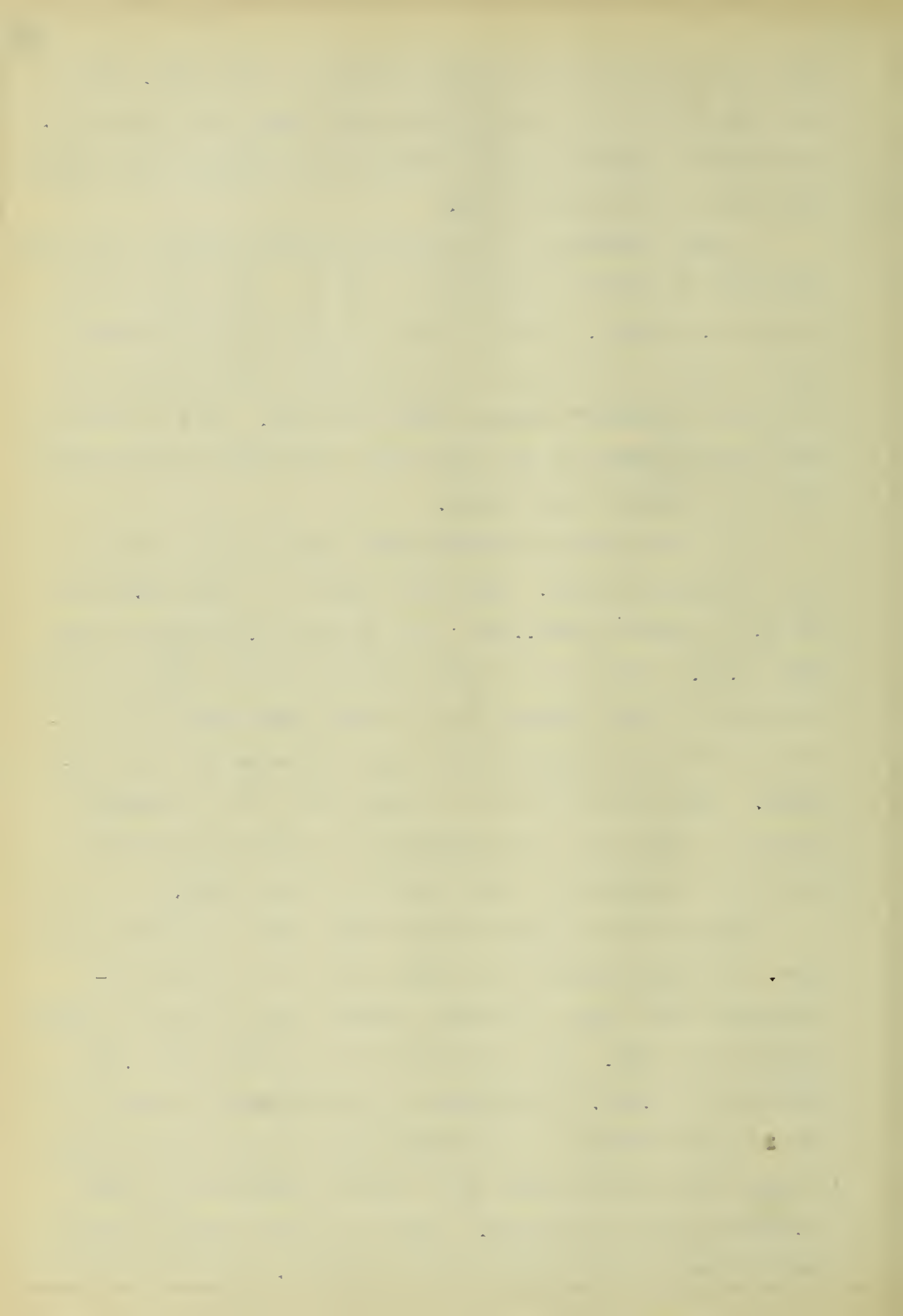
It was thought at first that the curve should start at 13# instead of 12# and it was run at that point for a week and then was dropped to 12#. This standard at first included both the water in the feeds and the water that was added to make the slop. Near the close, as much water was added as there was in the curve. Lot I had water before them all the time but received none in the feed, and Lot II had water at

will and also received a certain amount in their feed. The slop fed to Lot II was much thicker than that fed to Lot III. As could be expected Lot III followed the standard much closer than either of the other lots.

A rough smoothing of the curves show that Lot III ran about .6# under the 12# to 4# standard ; Lot II about 1# and Lot I about 1.7\$ under. The fact that Lots II and III were off feed so much of the time, kept their curves low although Lot II was not dependant upon the feed for water. From the 8th to the 13th week when Lot III made their best gains the curve follows the standard very closely.

All of the curves started fairly high but the curve of Lot I fluctuated wildy. The first week Lot I drank 10.7# of water, the second week 9.10# ; the 4th week 9.23# and the 6th week 4.8#. During all of this time the lot was eating all the feed given to them showing that in their case there was no relation between the amount of dry feed and water that was consumed. The sixth week which was about the 1st of December marked the time that cold weather set in which was the main cause for the big drop in the amount of water drank.

Both Lots II and III took more than 12# of water the first week. Lot III followed the standard and Lot II drank considerable water from the trough although they got most of their water in the slop. The second week Lot II drank only 9.78# and Lot III 12.59#. The change in the standard was made at the 3rd week because it was evident that the pigs were getting too much water particularly for a winter experiment and only 11.33# was fed at this time. Lots II and III went off feed in the 4th week and the curved dropped rapidly. As Lot II and III



went off feed in the 4th week and the curves dropped rapidly. As Lot II was not entirely dependant upon the slop for their water their curve held up better than that of Lot III. Lot III took only 8.67# and Lot II 9.27#. Lot III was off feed for two weeks and the second week they took 8.74# of water and . Lot II took only 8.80#. This was the first period of going off feed and was due probably to the factor of exercise. The pigs no longer spent time about the pens but preferred to stay in their cots. After this period of off feed Lot III did not have the capacity to take all the feed and water that the standards called for and it was necessary to work back to the standard for water rather gradually and at the 8th week they were back taking the exact amount that the standard called for. Lot II followed Lot I in water consumption in the 6th week when they dropped to 6.65# because of the cold weather and because they were still off feed. After the sixth week both of these lots made a gradual increase , Lot I taking 7.95# at the 9th week and Lot II 8.61# at the 10th week. From the 8th to the 13th weeks Lot III followed the standard closely using slightly above it at the 10th week and falling slightly below at the 12th and 13th weeks. There came the 2nd period of going off feed. During this time Lots I and II fluctuated as the weather was cold or warm. On some days Lot I drank 45 to 50# of water and on other days less than 30#, and these fluctuation extended into the weekly periods. Lot III was taking the least amount of water in the 13th week because they were off feed. As Lot II was still drinking considerable water from the trough it did not show as great a decrease as Lot III although it went

off feed quite badly. Both lots were off feed for several weeks and in the 15th week all 3 lots were affected. This was partly due to lack of tankage in the ration and because of cold weather; but all the lots took smaller amounts of water during that week than they had ever taken. The change in the method of calculating the rations that took place at this time tended to keep the curve for Lot III away from the standard but as the gains were not large enough to keep up the total amount of water it was necessary to use the standard as the amount to be added exclusive of what was in the feeds. After the 20th week Lot II drank practically no water from the trough but depended upon that in the slop. After the 16th week the standard had gotten so low that this lot followed it quite closely and during the last 3 weeks ran slightly over it. Lot III also finished above the standard and during the last week both lots received 4.49#.

During the fattening period Lot I did not show great fluctuations as they had before but rather a gradual decrease from 4.52# was made with a more rapid dropping away, at the close 2.71#.

A certain amount of water is necessary for the carrying on of digestive processes but a pig cannot be depended upon to take this amount of water. On cold days Lots I and II drank very little water while on warm days they drank large amounts. Curves representing the daily fluctuations would show much wider differences as the addition for the weeks tend to equalize the amounts. Lot III after the first did not have any difficulty in consuming the slop, and the slight amount of water that Lot II drank from the trough would indicate that

this lot was getting enough. When the factor of exercise was not acting against them Lot III was able to make much better gains than the other lots but they had fewer chances to do this as they missed many feeds. The following tables shows the amounts of water consumed per day per 100# . While not showing the variation as clearly as is shown on the chart the difference can be easily noted. In total amounts Lot III drank much more than Lot II and Lot II drank more than Lot I.

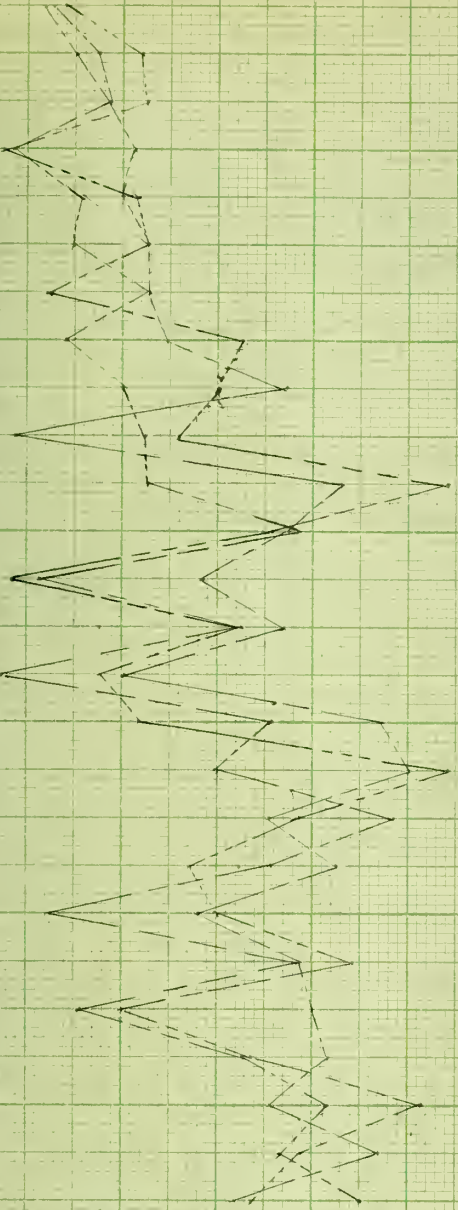
Water drank per 100# Live weight.

	I	II	III
1	10.747	12.44	12.86
2	9.10	9.78	12.59
3	9.53	10.45	11.33
4	8.23	9.27	8.67
5	8.92	8.80	8.74
6	4.83	6.65	9.28
7	5.65	6.81	9.10
8	6.51	7.41	9.88
9	7.95	7.35	9.54
10	7.14	8.61	9.51
11	6.22		
11	7.32	7.57	8.81
12	6.97	7.27	8.25
13	6.93	6.89	6.11
14	4.75	7.11	6.68
15	5.26	4.67	5.96
16	5.58	5.71	6.40
17	4.52	6.54	6.35
18	4.56	6.10	5.41
19		5.82	5.92
20	4.23	5.89	6.04
21	3.20	4.78	5.19
22	4.70	4.54	4.47
23	3.64	4.91	5.08
24b	3.85	4.81	4.54
25	3.00	4.68	4.45
26	2.71	4.49	4.49

Total amount of water drank was :

Lot I	Lot II	Lot III
6574.8#	6952.1#	8027.5#

Chart 6 gains per pig



Lot I
II
III
IV

The Gains per week.

Chart 6 represents the weekly gains of the averages of the lots. The figures at the top of the chart show the period and those at the left the value of the curves.

This chart by its great variation from week to week clearly illustrate the entire experiment. Lot I although not making very large gains made a slow and fairly steady increase in gains from start to finish while the other lots would go from one extreme to the other. Lot III, when conditions were favorable made very excellent gains but were unable to keep up the same rate. The amount of exercise the pigs took seemed to have great effect upon their appetites and hence influenced the gains. Lot I could not eat their feed very rapidly and had to spend a half hour or more at the trough while Lots II and III were through in five minutes and back in the cots lying down. The pens were so small that the pigs did not spend much time running about when not eating so that they got little exercise but Lot I had to spend more time on their feet than did the others hence they were better able to properly utilize the food as it was fed and did not go off feed as badly.

The first week Lot I made an average gain of 2.37# ; Lot II 2.75#, and Lot III 2.5#. The 2nd week Lot I made a gain of 3.1# ; Lot II 3.2# and Lot III 4.4#. The total gain for Lot III was held down because one pig lost 3# and had to be removed. The third week Lot III gained 3.5# and lots I and II gained 3.7#. This was an encouraging start as it seemed to show that Lot III was going to do much better than the other lots, but in

the 4th week the pigs were off feed and the advantage was lost. This was the first period during which Lots II and III went off feed and very slightly gains were made, Lot I made a steady increase in the average weekly gain until the 10th week when they made their poorest gain of the entire experiment. They were not affected as much by the adverse conditions of the experiment, yet were unable to make the good gains that Lot III made at times. The curve representing the gains made by Lot III is extremely erratic. At times it would rise to more than 10¢ per pig and then would fall in a straight line to less than 2¢. Lot I in one week only, made a poor gain and its curve runs fairly well from start to finish. Lot II, while its curve fluctuates wildly, did not reach the upper limits that Lot III did and the curves points downward much more often. This lot went off feed more than either of the other lots. The pigs could eat their feed as rapidly as Lot III so that the factor of exercise affected them equally and as they did not drink as much water so that they had that factor working against them also. Towards the close of the experiment they made steady gains and the last week made more than 2¢ more gain per pig than either of the other lots. In general there was a gradual increase of all three lots from 3¢ gain per head per week to 8¢ per head at the close.

The following table represents the average gain per pig per week. Slight gains were made at first while the pigs were small but a gradual increase is made except at off feed periods. Occasionally extra large gains were made but these did not often come two weeks in succession.

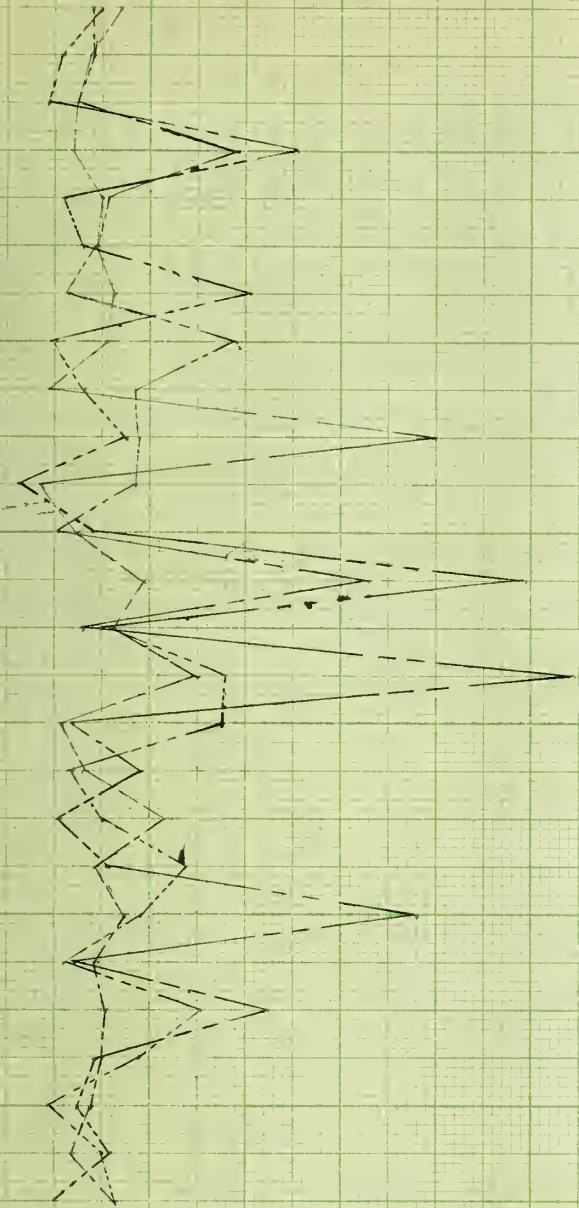
In average total gain Lot III is only 3.71# less than Lot I but its weight is an average of six pigs while that of Lot I is an average of seven pigs . The pig removed from Lot III was much smaller than the average of the lot. Lot II with an average gain for six pigs made a little more than twenty pounds less gain than Lot I .

Average Gain per Pig per Week.

	Lot I	Lot II	Lot III
1	2.37	3.14	2.85
2	3.00	3.42	4.00
3	3.71	3.71	4.57
4	4.28	1.71	1.42
5	4.00	3.14	4.28
6	4.57	3.00	4.57
7	4.57	4.57	2.57
8	4.85	2.85	6.57
9	7.42	4.00	6.00
10	1.71	4.42	5.14
11	8.59	4.57	10.85
12	7.42	7.71 ^c	7.14
13	5.71	2.28	1.71
14	7.42	6.57	6.57
15	4.00	1.42	3.42
16	9.42	7.14	4.28
17	10.00	6.00	10.00
18	7.14	9.71	7.71
19	8.57	7.14	5.42
20	6.57	2.57	6.00
21	7.71	7.71	8.85
22	8.00	3.14	4.00
23	8.28	6.57	6.66
24	7.14	8.33	10.33
25	9.42	7.33	7.66
26	6.28	9.00	6.66

Average Total gain		
162 .71#	142.83#	159#

Chart 7 cost per lb gain



24 25 26

The Cost per Pound Gain.

Chart 7 shows the cost per pound in gain. The figures at the top of the chart represent the periods and those at the left the value of the curves.

The curve representing the cost per pound gain is almost exactly opposite to the curve for the gains. During the off feed weeks when the gains fell the cost ran up high in spite of the fact that less feed was consumed during these periods. The average cost per pound gain in Lot I was \$.0404 ; in Lot II \$.0435 and in Lot III \$.0427. These figures are obtained when cornmeal is worth forty cents a bushel and dog flour twenty dollars a ton and tankage \$36 a ton. There are so many variations from week to week that it is almost impossible to describe the curves except in a general way. Most of the gains cost between 3c and 5c per pound except when very small gains or quite large gains were made. The 4th week for Lots II and III was a time of high priced gains. The cost for Lot III ran up to \$.0816 and to \$.0694 for Lot II. In the 10th week the gains for Lot I cost 11c per pound. The 13th week was another time for high prices for II and III, the gains for Lot II costing 9.63c and for Lot III 12.9c. In the 15th week the gains for Lot II cost 13.9c and in the 20th week 10.6c. These were the most costly gains that were made. Lot I made a total gain of 1141# at a total cost of \$46.125 for feed or at the rate of 4.04c per pound. Lot II made a total gain of 897# at a total cost of \$39.042 or at 4.35c a pound. Lot III a gain of 1004# and cost \$42.894 at a rate of 4.27c per pound.

The following tables give the exact figures by weeks for the cost of the gains of each lot . The average cost of the gains for the entire period one lower than a casual inspection of the costs of the gains per week would indicate. However, the high priced gains were small ones and the low priced gains large one .

Cost per one Pound Gain.

	Lot I	Lot II	Lot III
1	\$.0446	\$.0385	\$.0419
2	.0377	.0386	.0323
3	.0357	.0359	.0297
4	.0342	.0694	.0816
5	.0405	.0418	.0327
6	.0392	.0390	.0364
7	.0439	.0335	.0716
8	.0421	.0681	.0307
9	.0299	.0476	.0364
10	.110	.0483	.0453
11	.0279	.0477	.0233
12	.035	.031	.0337
13	.0496	.0963	.129
14	.0435	.0361	.0402
15	.0614	.1395	.066
16	.0325	.0545	.0654
17	.0371	.048	.0322
18	.0534	.0317	.0400
19	.0396	.0427	.0575
20	.0454	.106	.048
21	.0395	.0343	.031
22	.0417	.0754	.061
23	.0407	.0392	.048
24	.0387 ,	.0359	.0296
25	.0347	.0421	.0408
26	.0435	.0303	.0431
Average cost for entire period			
	.0404	.0435	.0427

Conclusions.

The experiment did not run very smoothly for the pigs were off feed at many different times. Lots II and III had two general off feed periods. The first started at the 4th week and the second at the 13th. At the latter time Lot I also went off feed. There was no explanation for these disturbances except that the pigs did not take enough exercise. This affected Lots II and III more than it did Lot I. They went off feed oftener and to a greater degree than Lot I. Lot I consumed all of its feed until the 10th week, while the other lots went off in the 4th week. This can be traced to the different amount of exercise taken by the lots. Lot I had to stand on their feet much longer while eating their feed than the other lots. The slops fed to Lots II and III could be disposed of in a very few minutes but the dry feed of Lot I had to be eaten slowly. Apparently the systems of Lots II and III would be gradually clogged up, and they would refuse part or all of their feed for a few days, until they cleared their system and were once more ready to consume their feed. After a period of off feed they were able to take all their feed for some time, but they were gradually filled up again, and another off feed period would run. Even lot I was affected at times although they were better able to utilize all the feed as it was given to them.

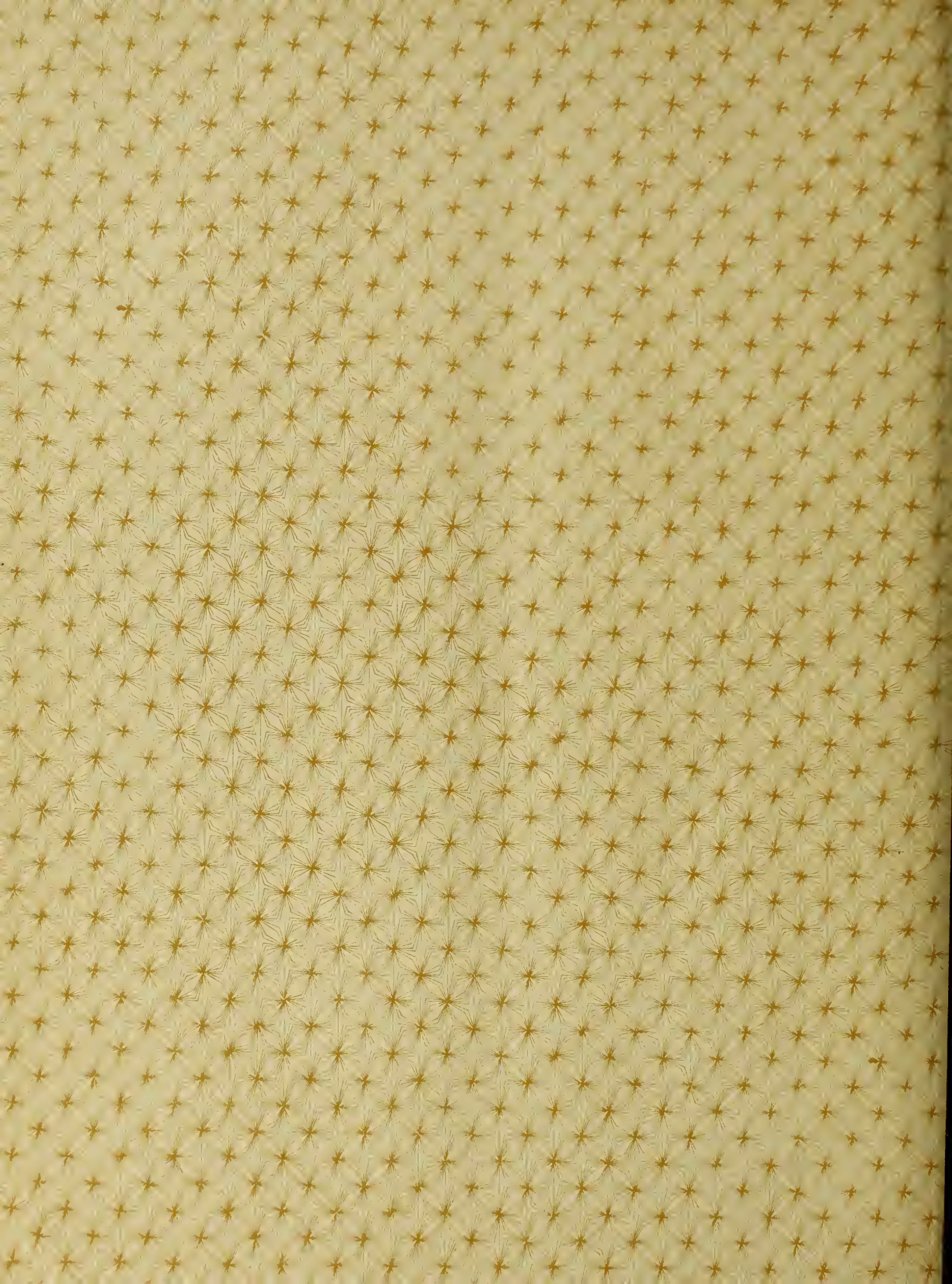
These periods of clogging up of the systems affected some

of the young pigs to such an extent that they never recovered, and had to be removed from the experiment. Lots II and III were about equally effected by this factor of exercise as they both spent about the same amount of time in their cots, but Lot III made much **better** gains than Lot II. The only other difference between the lots was the manner in which the water was given to them. Lot III received at all times their stated amount of water while Lot II could control to a large extent the amount of water they drank, and they drank a much smaller amount than Lot III. This is a further proof added to those of former experiments that a thin slop gives much better results than a thick one. Pigs receiving a thick slop take very little water in cold weather; but the feed does not contain enough water to properly carry on the processes of assimilation.

Lot I did not make very good gains when compared with the best periods of Lot III. Although they seemed in excellent condition most of the time their gains were only fair while Lot III, when not affected, was able to make much larger gains than the dry feed lot. However, as each succeeding period of off feed left them in poorer shape to ward off the next one, it was not often that they made good gains. Even the decrease that was made in the feeds after the 15th week did not keep them from going off feed. But with these conditions against Lot III the conclusions that dry feed is better than a thin slop cannot be drawn although Lot I finished with a higher weight than Lot III.

The gains that pigs will make depend largely upon the amount of water consumed. Lot III was fed the proper amount

of water in their feed , making a thin slop, and made the largest gains except when these gains were affected by the factor of exercise which had not been considered. Lot II drank more water than Lot I, but did not make as large nor as economical gains because they were affected by the factor of exercise to a greater extent than Lot I. Lot I although being fed dry feed made the largest^{gains} which shows that some thing, other than the water factor, entered into the experiment.





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